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ELECTRICAL AND PHYSICAL PROPERTIES OF METALLIZATION ON BASIS OF BINARY AND TRIPLE ALLOYS

FUNCTIONALIZATION OF MATERIAL SURFACES

Degradation phenomena in aluminum metallization, connect with masstransfer and interdiffusion processes in a contact area, which intensify solid phase silicon solution in aluminum, were investigated in this work. Perfection of aluminum metallization with application of thin films of alloys containing holmium and creation of ohmic contacts with impulse optical bake were studied.

Regularities, connecting formation conditions of aluminum thin films, containing silicon and holmium, by magnetron sputtering with films structure, with their stability by heat treatment, with contact resistivity were investigated [1]. These regularities were explained with the use of methods of transmission electron microscopy and electro-physical analysis.

It is shown, that films of aluminum alloy, containing 1% silicon and 0.8% holmium, with definite temperature regimes of deposition and of bake possess the best combination of electrical and morphological properties. Better temperature stability is typical for films from this alloy, which is displayed in absence on the surface of protuberances with the height $\geq$ 0,2 μm, stipulated by recrystallization.

Problems of fabrication of reliable resistance contacts were studied. For this purpose processes of solid phase interaction in Si-Al contact system were investigated [2].

Basis on the results of electron microscopy investigations anisotropy character of silicon solution in contact area in real conditions was shown. Experimental estimation of silicon solution volume carried out taking into account the density and dimensions of observed local etch holes.

Experimental results testify, that most large etch holes are situated on the contact window periphery. This location is explained by high gradient stress along boundaries

of contact window, which appear because of the difference of silicon and oxide thermal expansion coefficients.

Modifying influence of holmium additives on the condition of boundary of Si-Al contact system was determined. This permits to achieve next positive effects:

1) application of aluminum alloy with holmium ensures decrease depth and etch holes sizes with synchronous increase of their density in contact area. This is explained by holmium atoms hitting the silicon substrate while sputtering target which being surface active additive easily enter into interaction with uncontrolled additive being in silicon oxide barrier layer. It promotes leveling of silicon solution velocity in aluminum along contact area;

2) application of aluminum alloy with silicon and holmium ensures decrease defects density and defects sizes in contact area stipulated by second silicon precipitation. Addition of holmium as third ingredient in alloy, containing silicon, reduces silicon atom migration in aluminum films, rises silicon nucleation energy and hinders their growth.

Influence of impulse optical bake of millisecond range on character of interaction in Si-Al contact system was studied. It is shown, that depth of silicon penetration in aluminum film calculated by correlation for diffusion length is much less (~ 0,1 μm), than by bake in diffusion furnace in comparable temperature regimes.

Equal correlation between theoretical and experimental estimations of volume and silicon solution depth by thermal and optical bake indicate the same mechanism of solid phase interaction process of aluminum film with silicon substrate. But because of short impulse optical bake of degradation phenomena connected with silicon substrate erosion in contact area is less. Besides, in films containing silicon diffusion length of silicon atoms is also small that leads to decrease of density and sizes of second silicon precipitates in contact area.

Obtained results show the perspective usage of developed methods which use aluminum alloys containing holmium and impulse optical bake for solution of problems of fabrication of reliable ohmic contacts.

References:

[1] C. Colinet and A. Pasturel, in Handbook on the Physics and Chemistry of Rare Earths, ed. K. A. Gschneidner, Jr. and L. Eyring, North-Holland, Amsterdam, 1994, vol. 19, p. 479.

[2] Sasano J., Schmuki P., Sakka T., Ogata Y. H. Maskless patterning of various kinds of metals onto porous silicon // Extended abstracts of the 4-th international conference PSST- 2004. – Valencia, Spain, 14-19 March, 2004. – P1-64.